Exchange Bias and Circularly Polarized Soft X-Rays

Beamline: X13A

Technique: Soft x-ray magnetic scattering

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C. Sánchez-Hanke and C-C.Kao. "An element sensitive hysteresis loop study of an exchange biased Co/NiO bilayer"
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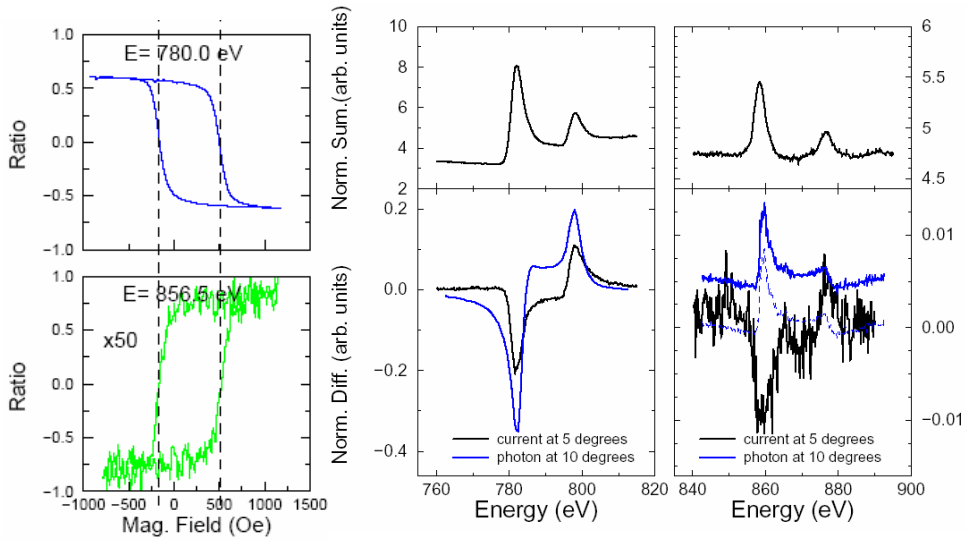
Motivation: Exchange bias, or the shift of the hysteresis loop from the zero position, is a highly interesting magnetic effect with technological applications. The origin of the shift has been studied since its discovery in the 40's. This effect is common in samples were ferromagnetic (FM) and antiferromagnetic (AFM) elements share an interface. Three different mechanisms have been proposed to explain the effect - experiments are needed to distinguish the mechanisms.



(Left) Element specific hysteresis loops recorded in reflection at the Co and NI L_{III} absorption edges. Both loops present the same coercive field and the same exchange bias field. (Right) MCD curves recorded at 5 (black) and 10 (blue) degrees using respectively the current and total reflection of the sample.

Results: A Co/NiO bilayer was studied with fast modulated elliptically polarized soft x-rays at X13A. Fast switching combined with lock-in techniques allow us to record small magnetic signals associated with the Co (FM) and with the NiO (AFM) layers. Left hand figures show the hysteresis loops associated with each layer. Surprisingly the AFM layer also shows a hysteresis loop, "antiferromagnetically" oriented to the FM layer. To find out if the origin of the exchange bias on this sample is located at the interface between layers or is buried in the AFM layer, we performed magnetic circular dicroism (MCD) measurements using the sample current and the reflection of the sample. In the Co case (left) both MCD curves present the same orientation. At the Ni edge the sample current MCD has the same orientation as the Co. Meanwhile the Co recorded from the total reflection of the sample has the opposite orientation. These could indicate that the coupling between the Co and the NiO is ferromagnetic at the interface and that inside the NiO there are a certain number of spins antiferromagnetically coupled to the Co ones.